1. Consider the following formulas of efficiency of heat engine:

I: $\eta = 1 - \frac{T_2}{T_1}$

II: $\eta = 1 - \frac{Q_2}{Q_1}$

$T_1, T_2 \rightarrow$ temperature of source and sink respectively

$Q_1, Q_2 \rightarrow$ heat extracted from source and heat rejected to sink respectively

Which formula should be used to find out thermal efficiency of an irreversible heat engine

(a) Only I (b) Only II

(c) Both I and II (d) Can't say

2. Efficiency of Carnot Engine can be increased by:

(a) Increasing temperature of source by ΔT

(b) Decreasing temperature of sink by ΔT

(c) Either (a) or (b)

(d) None of these

3. $0.4m^3$ of air at 2 bar and $60^\circ C$ is compressed to $0.05m^3$ according to the law $PV^{1.2} =$ constant. Heat is added at constant volume till its pressure is 30 bar. Change in entropy in each case respectively in (kJ/K) is:-

(a)-0.24976, 0.12769

(b)-0.12769, 0.24976

(c)-0.13468, 0.83452

(d)-0.83452, 0.13468

4. Two k.g. of air undergoes an irreversible process between equilibrium state1 (40^0C,4 bar) and equilibrium state 2 (40^0C,8 bar). The change in entropy $(s_2 - s_1)$ is _____(kJ/K)

5. A carnot engine operates b/w 800K and 400K and produces 400kJ of work. Entropy change during heat addition is:-

(a) 0.5 kJ/K (b) 1.5 kJ/K

(c) 1.0 kJ/K (d) 2.0 kJ/K

6. Consider the following expression:

$$-T\left(\frac{\partial V}{\partial T}\right)_P^2 \left(\frac{\partial P}{\partial V}\right)_T$$

It represents:-

(a) Isothermal Compressibilty

(b) Volume Expensivity

(c) Difference in Heat Capacities

(d) Universal Gas Constant

7. A heat engine operates between 290^0C and 8.5^0C. 300 kJ/s of heat is supplied at 290^0C and 75 kJ/s of heat is rejected at 8.5^0C. This heat engine is:-

(a) Reversible (b) Irreversible

(c) Impossible (d) Insufficient information

8. A system is initially at 250K and a heat reservoir at 125K is available. Calculate the maximum amount of work that can be recovered as the system is cooled down to temperature of reservoir. It is given that heat capacity of system is $C = \alpha T^2 \left(\alpha = 0.045 J / K^3\right)$

(a) 73.24 kJ (b) 84.65 kJ
(c) 90.84 kJ (d) 60 kJ

9. Consider the following statements:-
When a perfect gas enclosed in a cylinder piston device executes a reversible adiabatic expansion process:
(1) Its entropy will increae
(2) Its entropy change will be zero
(3) The entropy change of the surroundings will be zero
Which of these statements is/are correct?

(a) 1 and 3 (b) Only 2
(c) 2 and 3 (d) Only1

10. 10 kg of water is heated from 300K to 350K in an insulated tank due to churning action by stirrer. Ambient temperature is 300K. Find loss of availability ($C_{water} = 4.18 kJ / kgK$)

(a) 1500 kJ (b) 2998 kJ
(c) 4968 kJ (d) 1932 kJ